MSK1A Series

LED Control and Drive Synthesizer

Version 1.1

Aug. 6, 2012

Revision History

Version	Date	Description	Modified Page
1.0	2012/4/12	Formally release.	-
1.1	2012/8/6	Modify VDD numeric of Fosc column.	8

1. 概述

MSK1A系列產品為單晶片CMOS的LED控制驅動合成IC，共有2個母體分別為 MSK1A003A和MSK1A103A。利用精準的內阻震盪故不需外加震盪電阻，每個Output可分別提供不同的電流輸出並搭配軟體電流控制來驅動不同亮度的LED，還可選擇定電流輸出以保護LED，故無須再外加限流電阻。閃燈合成方式為可程式的方波、斜線和曲線，可任意組成出各種閃爍方式，藉由製造過程中更換Code光罩，可將不同的閃燈資料寫入ROM中。用戶可使用簡便的 Q-Light 工具軟體來快速地進行開發。

2. 功能

(1). 寬廣的工作電壓： 1.6V ~ 6.4V。

(2). 共有2個母體，可支援的I/O腳和ROM大小如下：

P/N	MSK1A003A	MSK1A103A
I/O	1*I/O, 2*O	1*I/O, 2*O
ROM	DC0H	1B80H

(3). MSK1Ax03A有3個I/O腳: TG 可選擇作輸入腳或是輸出腳，O1, O2 只能作爲輸出腳來推LED。(光罩選擇)

(4). 閃燈最多可被分割成8個閃燈段(Section)，每段長度可不同，每一閃燈段中的閃燈採樣點數必須爲40H (Hex)的整數倍。同個時間的每個採樣點可選擇的基本時間單位爲1/128秒或1/16秒，並可搭配 x1, x2, x4, x8 的時間倍數(Extension)選項，因此每個採樣點共有7種時間長度可選擇 (1/128, 1/64, 1/32, 1/16, 1/8, 1/4, 1/2 秒)。

(5). MSK1Ax03A 最多有64個閃燈格(Step)，只可規劃成1個閃燈組(Sentence)，TG 能用來指定這個閃燈組(Sentence)。每一閃燈格(Step)可指定任一個閃燈段(Section)和TG、O1、O2 的輸出搭配 (當TG設為輸出時)。

(6). 閃燈最多爲3通道輸出(TG設爲輸出腳)，每個通道可分別自訂一組可程式的PWM方波(Flashing)或漸明漸暗的斜線(Ascend/Descend)。每段方波還可分別定義成0%~100%不同的高度，不同的高度設定可以讓LED產生不同的亮度變化，而每段斜線最多有128階變化，可以讓LED產生漸明或漸暗的效果。

(7). 只有內建一組準確的頻率振盪器(+/- 3% 誤差)，並無提供外部震盪電阻選項。

(8). TG輸入腳的輸入選項：(光罩選擇)

(a). 可分別選擇 Edge/Level, Hold/Unhold, Retrigger/Irretrigger 不同的觸發方式組合。

(b). 可分別選擇 CDS+1.5M、CDS、1.5M 的下拉電阻 或 Floating。(CDS+1.5M選項: 當按鍵按下時，IC內部爲 1.5MΩ 的下拉電阻；而當按鍵放開時，IC內部爲 300KΩ+1.5MΩ 並聯 的下拉電阻 約250KΩ。 CDS選項: 當按鍵按下時，IC內部爲 Floating；而當按鍵放開時，IC內部為 300KΩ 的下拉電阻。)

(c). 可分別選擇Debounce時間：Long – 10ms 給一般按鍵使用；Short – 50us 給彈跳開關使用。

(d).可選擇是否有 Toggle On/Off 的功能 (1st 觸發 → 播放，2nd 觸發 → 停止，……)。

(9). 所有的輸出腳都有以下 3 種輸出選項：(光罩選擇)

(a). Large Sink Current Output (大灌電流輸出)：輸出腳接LED到VDD。(Iol=57mA/75mA @VDD=3V/4.5V)

(b). Constant Sink Current Output (定灌電流輸出)：輸出腳接LED到VDD，VDD=3V和4.5V的輸出電流爲恆定電流，不會因爲VDD不同而影響到LED亮度，有20mA和30mA兩種定電流選項。

(c). Drive Current Output (拉電流輸出)：輸出腳接LED到GND。(Ioh=10mA/15mA @VDD=3V/4.5V)

(10). 每個輸出腳都可分別設定爲不同的電流：(光罩選擇)

(a). Large Sink Current (大灌電流)：提供4種不同輸出電流 100%, 83%, 50%, 33%。

(b). Constant Sink Current (定灌電流)：提供4種不同輸出電流 100%, 83%, 50%, 33%。

(c). Drive Current (拉電流)：只有一種電流 100%。

(11). 特殊功能選項 "上電播放" (Power-On-Play, POP)： 電池一上電立即播放一次" 上電播放閃燈組" (POP Sentence)，觸發模式固定為 Edge / Unhold / Retrigger。如果POP結合 Power-On-Loop (POL) 功能，則上電會循環播放" 上電播放閃燈組" (POP Sentence)，直到TG按鍵被觸發才會停止，當TG按鍵被觸發時，上電播放會立即停止並播放該TG的閃燈組。

※ 注意: POP Sentence 和 TG Sentence 是相同的。

(12). 特殊功能選項 "短觸發循環播放" (Edge-Loop)：當TG按鍵一被觸發，TG的閃燈組會一直循環播放。如果結合 Loop On/Off 功能，再觸發該按鍵，閃燈會停止，再次觸發則循環播放TG的閃燈組。

※ 注意: Loop On/Off 與 Toggle On/Off 不能同時存在。

(13). 特殊功能選項 "雜訊觸發" (Noise-Trigger)： 當選擇此功能時，TG被設定爲 Edge/Unhold 功能，應用時需將TG輸入在PCB的Layout做成較長的輸入線，當外部有較大的雜訊產生時，利用天線效應的原理來產生輸入訊號，TG外部懸空不需連接到VDD或GND腳。(此功能常見於電子打火機和手機天線的應用)

(14). 低壓復位(LVR) 選項，當電壓瞬間低於1.5V時，IC 會自動復位。(光罩選擇)

(要進一步了解上述功能，請參考Q-Light的使用手冊，或聯繫迈思凯科技或迈思凯代理商。)

1. GENERAL DESCRIPTION

The MSK1A series are single-chip LED Control and Drive synthesizing CMOS IC. There are 2 bodies: MSK1A003A and MSK1A103A. Through the accurate internal oscillation of built-in Rosc, an external Rosc is not required. Each output can provide different kinds of current output cooperating with software current control to drive different brightness LED, and optional constant current is also provided to protect LED, thus it's not necessary to add the external current-limit resistor. The LED pattern consists of programmable square waveform, oblique and curve, user can compose varied pattern and then the customized LED data can be programmed into ROM by changing one code mask during fabrication. Besides, the interactive software developing tool of "Q-Light" is user-friendly and quick for programming.

2. FEATURES

(1). Wide operating voltage: 1.6V ~ 6.4V.

(2). There are 2 bodies. The I/O counts and maximum ROM size are as following.

P/N	MSK1A003A	MSK1A103A
I/O	1*I/O, 2*O	1*I/O, 2*O
ROM	DC0H	1B80H

(3). MSK1Ax03A has 3 I/O pins: TG can be either input or output pin. The O1 and O2 can only be output pin. (Mask option)

(4). The total LED pattern can be partitioned up to maximum 8 LED Sections. Each LED Section length is flexible. The LED Section data length must be the multiple of 40H (Hex). The time unit of each LED sample can be 1/128 sec or 1/16 sec. Cooperating with time extension option of x1, x2, x4 and x8, there are total 7 options selectable. (1/128, 1/64, 1/32, 1/16, 1/8, 1/4, 1/2 sec)

(5). For MSK1Ax03A, maximum 64 LED Steps are available for 1 LED Sentences. TG input can assign this Sentences independently. Each Step can specify one LED Section and enable/disable TG, O1 and O2 output option if TG is set as output.

(6). There are maximum 3 channels of LED. Each channel can be assigned one set of programmable PWM square waveform (Flashing) and/or fade-in/fade-out oblique (Ascend/Descend). Every PWM square waveform can be set as different level of 0%~100% amplitude to control the LED brightness, and every oblique has maximum 128 levels variation to generate fade-in or fade-out effect.

(7). Only build in an accurate internal oscillator of +/- 3% tolerance, no external R oscillator.

(8). TG Input option for input pin. (Mask option)

(a). TG input can select Edge/Level, Hold/Unhold and Retrigger/Irretrigger trigger modes.

(b). TG input can select CDS+1.5M, CDS, 1.5M pull-low resistor or Floating type.

(CDS+1.5M option: Only 1.5MΩ pull-low resistance at key-pressed, and 300KΩ+1.5MΩ in parallel pull-low resistance around 250KΩ at key-released. CDS option: Floating at key-pressed, and 300KΩ pull-low resistance at key-released.)

(c). TG input can select Debounce time: Long debounce of 10ms for push-button. Short debounce of 50us for fast switch.

(d). TG input can select Toggle On/Off function (1st Trigger → play, 2nd trigger → stop, ……).

(9). There are 3 kinds of output option for all output pins. (Mask option)

(a). Large Sink Current output: Output is connected a LED with VDD. (Iol=57mA/75mA @VDD=3V/4.5V)

(b). Constant Sink Current output: Output is connected a LED with VDD. Whenever VDD is 3V or 4.5V, the output current is constant and LED brightness is uniform. There are two options of 20mA and 30mA for constant current.

(c). Drive Current output: Output is connected a LED with GND. (Ioh=10mA/15mA @VDD=3V/4.5V)

(10). There are different current options for each output pin. (Mask option)

(a). Large Sink Current: 4 kinds of sink current output, 100%, 83%, 50%, 33%.

(b). Constant Sink Current: 4 kinds of constant sink current output, 100%, 83%, 50% and 33%.

(c). Drive Current: only one kind of drive current output, 100%.

(11). “Power-On-Play” special function (POP): When power is on, play the POP Sentence one time. The trigger mode is fixed as Edge / Unhold / Retrigger. To cooperate with Power-On-Loop (POL) function, the POP Sentence will be played in loop until TG key-trigger happened. When TG key is triggered, it stops playing the POP Sentence and immediately plays the TG sentence.

※ Note: POP Sentence is same as TG Sentence.

(12). “Edge-Loop” special function: When TG is triggered, playing the sentence in loop. To cooperate with Loop On/Off function, stop playing if triggered once more, and play the sentence in loop once key is triggered again.

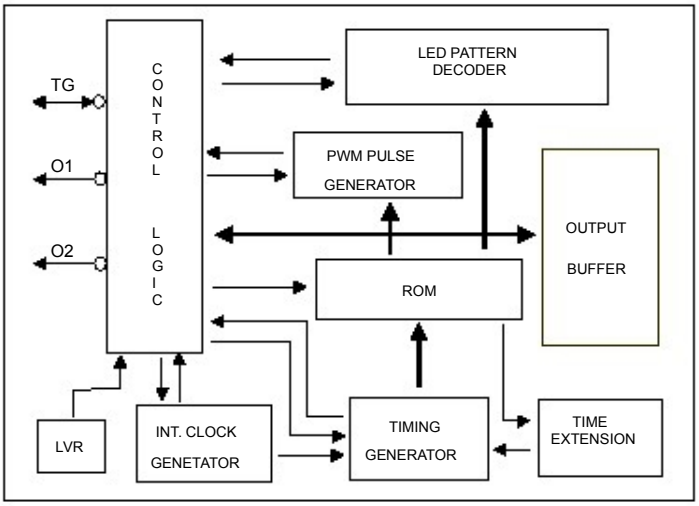
※ Note: Loop On/Off and Toggle On/Off cannot be optioned together.

(13). “Noise-Trigger” special function: When this function is selected, TG is set as Edge/Unhold function. In PCB layout, TG input needs a longer input line. By antenna effect, it takes place an input signal when larger noise happens outside. TG is floating externally and is not necessary to connect to VDD or GND. It’s popular in electric lighter or mobile antenna application.

(14). Low-Voltage-Reset (LVR) option. When voltage is lower than 1.5V, IC will reset by itself. (Mask Option)

(For details of the above functions, please refer to Q-Light user manual, or contact Mysky or her agents.)

3. BLOCK DIAGRAM



4. PAD DESCRIPTION

Pad Name	Pad No.	ATTR.	Description
TG	1	I/O	Input or output pin. To be input, active high.
VDD	2	Power	Positive power.
GND	3	Power	Negative power.
O1	4	O	Output pin.
O2	5	O	Output pin.

5. DEVELOPMENT, DEMONSTRATION

User can use “Q-Light“ software tool to develop the desired functions. After finishing the code programming, user will get 2 files of “.bin” and “.htm”, the binary file and function checking list. Through “FDB_Writer” operation, user can download the “.bin” file into MSK1_FDB flash demo board to demonstrate the MSK1A function. Once the function has been approved, user only needs to send the “.bin” file to Mysky for code release. For more details, please refer to “Q-Light” user manual.

2Mb Flash Demo board	MSK1_FDB-02
Max. demo body	MSK1A103A

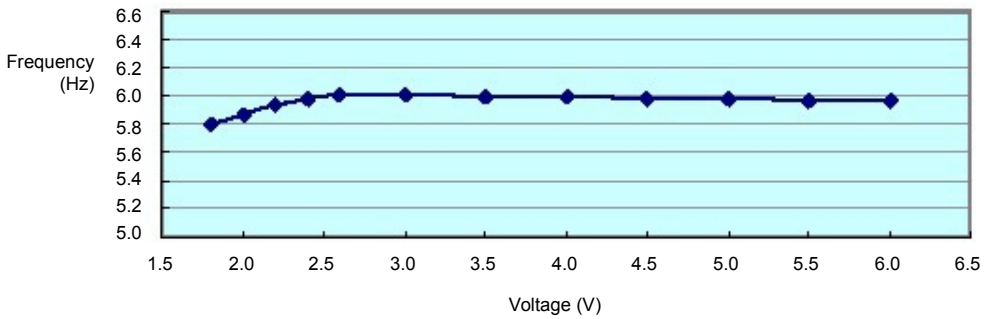
6. ABSOLUTE MAXIMUM RATING

Symbol	Rating	Unit
VDD~GND	-0.5 ~ +7.0	V
Vin	GND-0.3 < Vin < VDD+0.3	V
Vout	GND < Vout < VDD	V
Top (operating)	-0 ~ +70	ºC
Tst (storage)	-55 ~ +150	ºC

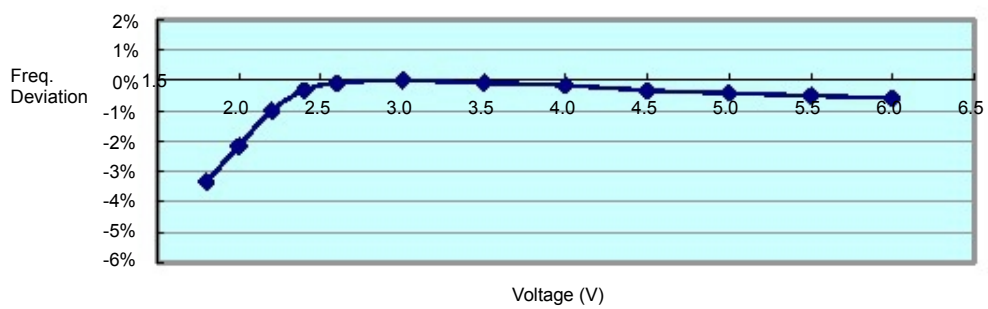
7. DC CHARACTERISTICS

Symbol	Parameter		Min.	Typ.	Max.	Unit	Condition
VDD	Operating voltage		1.6	3.0	6.4	V	
Isb	Standby current, VDD=3V/4.5V			0.5	1	uA	No loading
Iop	Operating current	VDD=3V		0.2		mA	
		VDD=4.5V		0.5			
Iih	Input current (1.5M ohms pull-low)			2		uA	VDD=3V
				6			VDD=4.5V
Ioh	Output drive current			-10		mA	VDD=3V, Voh=2.0V
				-15			VDD=4.5V, Voh=3.5V
Iol	Output large sink current			57		mA	VDD=3V, Vol=1.0V
				75			VDD=4.5V, Vol=1.0V
	Output constant sink current (20mA option)			20		mA	VDD=3V, Vol=1.0V
				21			VDD=4.5V, Vol=1.0V
	Output constant sink current (30mA option)			28		mA	VDD=3V, Vol=1.0V
				30			VDD=4.5V, Vol=1.0V
ΔF/F	Frequency deviation by voltage drop	VDD=3V		-0.5		%	$\frac{Fosc(3.0v)-Fosc(2.4v)}{Fosc(3v)}$
		VDD=4.5V		-1			$\frac{Fosc(4.5v)-Fosc(3.0v)}{Fosc(4.5v)}$
ΔF/F	Frequency lot deviation, (VDD=3V)		-3		3	%	$\frac{Fmax(3.0v)-Fmin(3.0v)}{Fmax(3.0v)}$
Fosc	Oscillation Frequency		420	524	560	KHz	VDD=1.6~6.4V

Voltage vs Frequency (LED=6.0Hz Flash @3V)



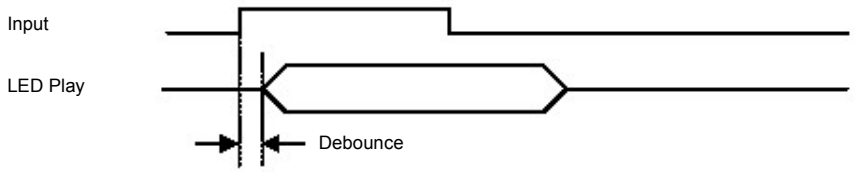
Voltage vs Freq. Deviation (LED=6.0Hz Flash @3V)



8. TIMING DIAGRAM

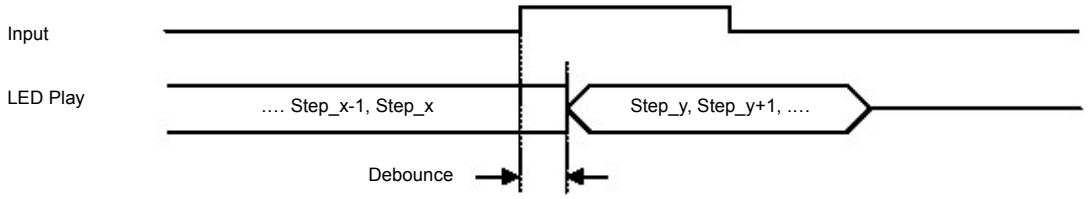
(1) Debounce Time

(a). Trigger while not playing LED

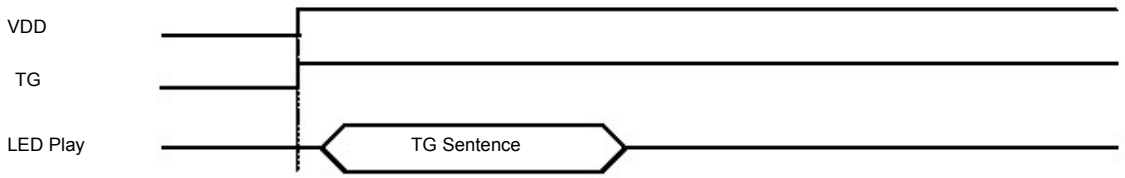


※ Debounce time is configured by Long debounce = 10ms, Short debounce = 50us

(b). Trigger While playing LED



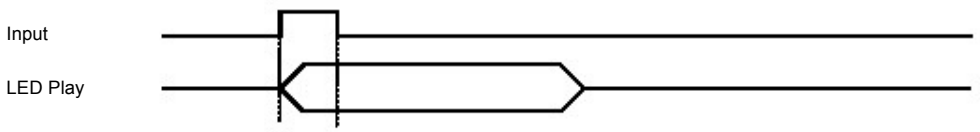
(2) Input Priority



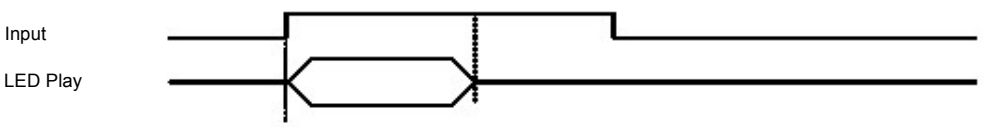
※ Priority: TG > POP (Power-On-Play)

(3) Basic Operation

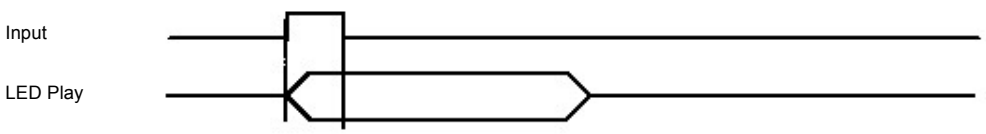
(a). Edge mode, Edge trigger



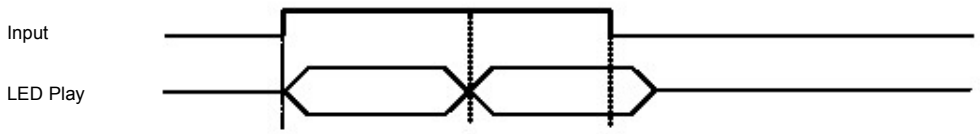
(b). Edge mode, Level trigger



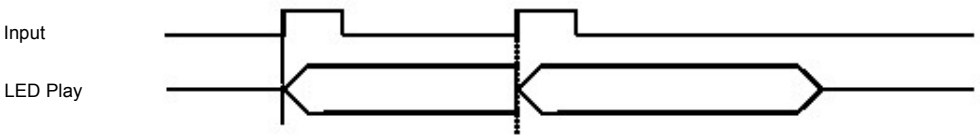
(c). Level mode, Edge trigger



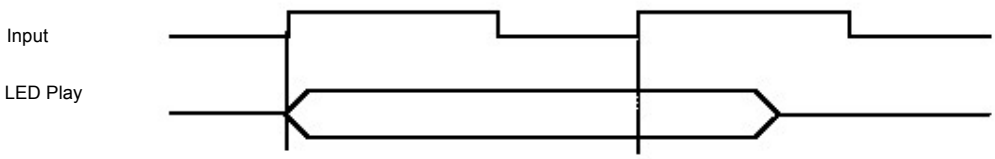
(d). Level mode, Level trigger



(e). Retrigger mode



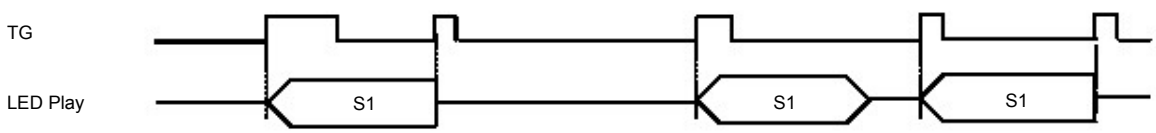
(f). Irretrigger mode



(4) Advanced Operation

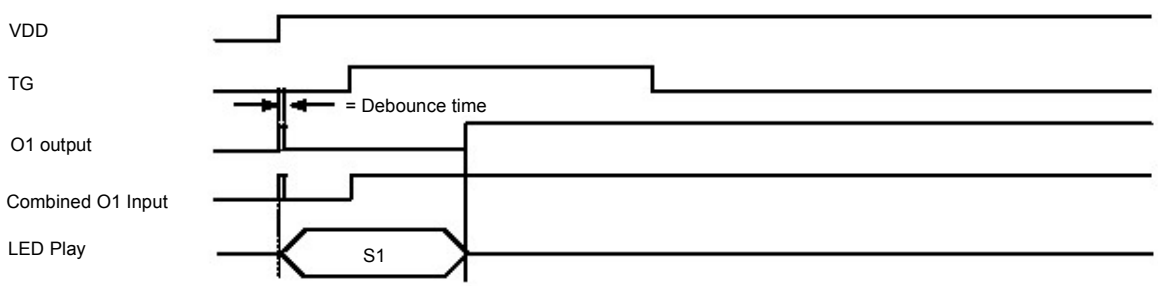
(a). Toggle On/Off Function

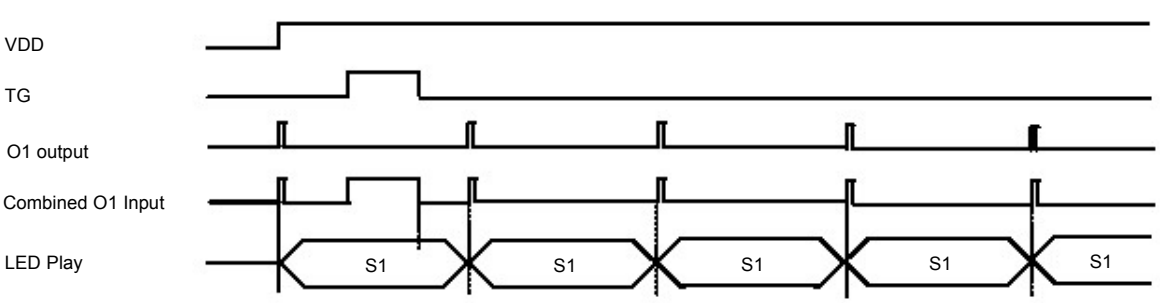
TG (E/U/R) =S1



(b). External Feedback Function (O1 is output and connected to TG input)

TG (E/U/I) = S1, O1= Sink Mode (When not playing LED, O1 is high, i.e. Busy_Low.)



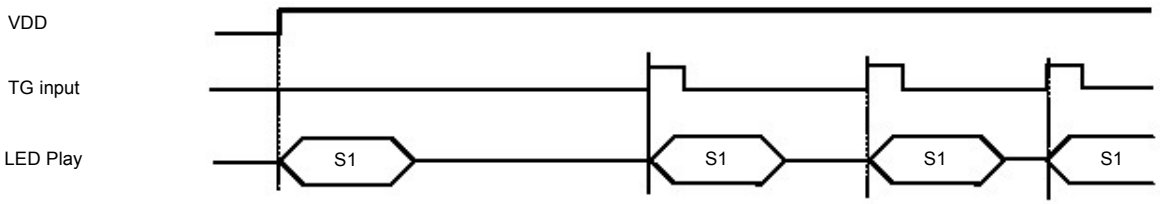


※ When power on, O1 will generate a high pulse at Busy_low status and the duration is equal to debounce time.

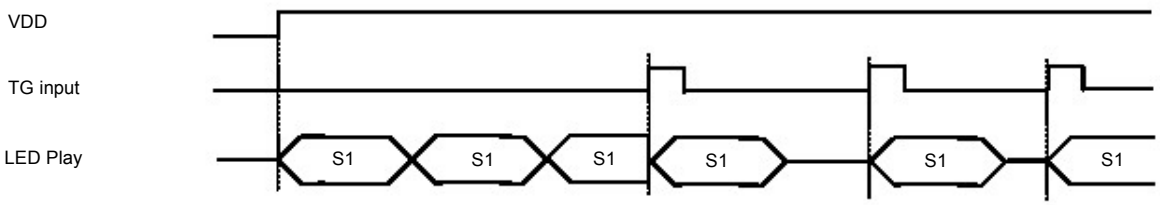
(c). Power-On-Play (POP) Function

The trigger mode of Power-On-Play is fixed as E/U/R, TG trigger-signal will stop POP's LED immediately and play the TG's LED. POP can cooperate with Power-On-Loop function to play POP Sentence in loop.

(c-1) TG (E/U/I) = S1, POP (E/U/R) = TG

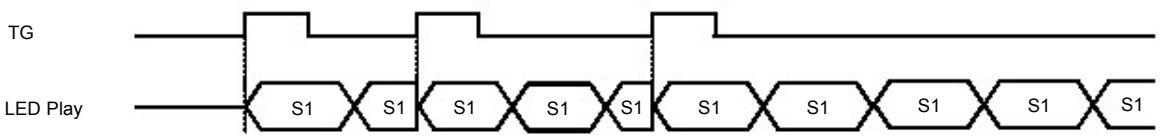


(c-2) TG (E/U/I) = S1, POP (E/U/R) = TG, Power-On-Loop (POL) is enabled.

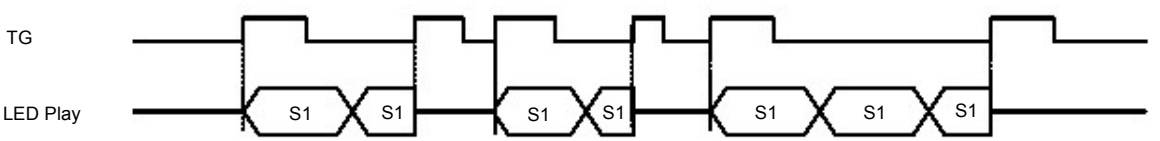


(d). Edge-Loop Function

(d-1) TG (E/U/R) = S1

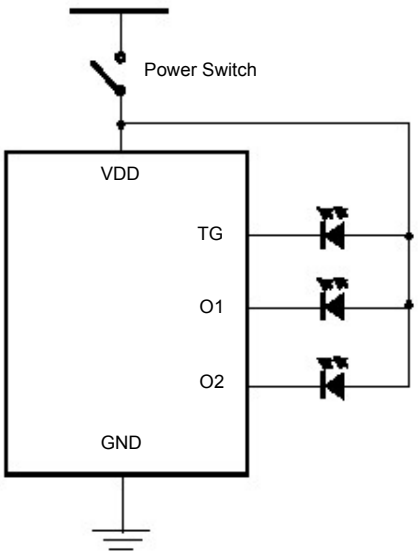


(d-2) TG (E/U/R) = S, Loop On/Off is enabled.

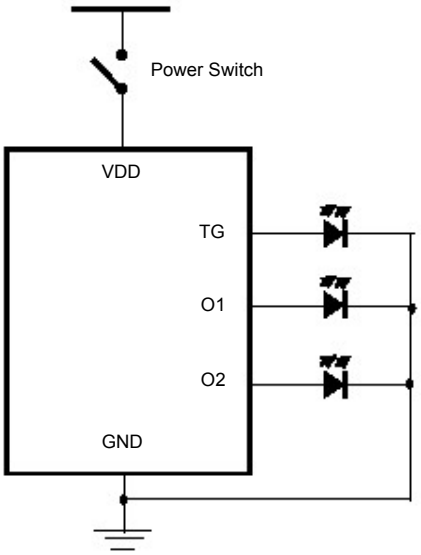


9. APPLICATION

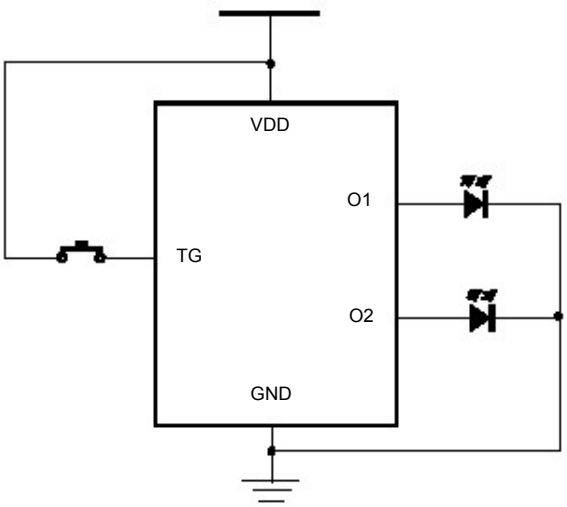
(1) POP with 3 LEDs (3*Sink)



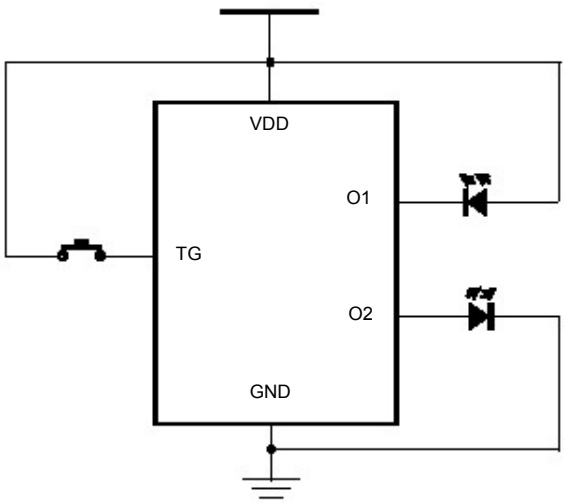
(2) POP with 3 LEDs (3*Drive)



(3) 1 Alone trigger with 2 LEDs (2*Drive)

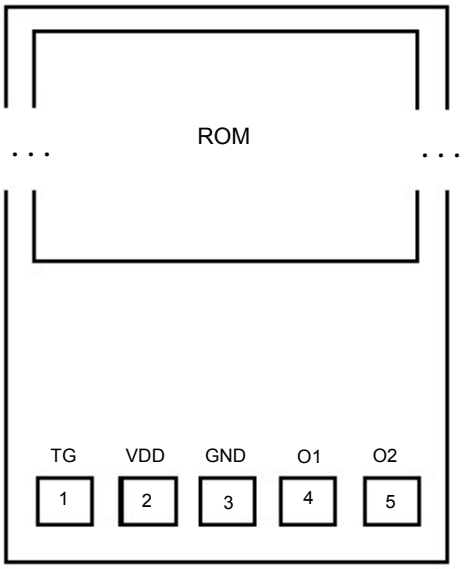


(4) 1 Alone trigger with 2 LEDs (1*Sink, 1*Drive)



* Please contact Mysky or her agents for more application such as LED Lighting, LCD Backlight, LED Torch or RGB Lighting.

10. DIE PAD DIAGRAM



* The IC substrate must be connected to GND or Floating.